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(54) Abstract Title

Television signal flare correction for use in a camcorder

(57) In a flare correction apparatus to correct flare of a digital image signal including digital red data (R), digital green data (G) and digital blue data (B), each of the R, G and B containing a plurality of horizontal lines (HL's), each HL having predetermined N number of pixels, a RGB-data flare correction circuit 200 performs a flare correction on HL's of the R, G and B on a HL-by-HL in accordance with a predetermined flare correction method to thereby provide flare corrected red, green and blue data (Rc), (Gc) and (Bc), respectively. And then an image signal converting circuit 300 performs an image signal conversion on the Rc, the Gc and the Bc to thereby generate a luminance signal (Y) and a chrominance signal, wherein the Y includes a plurality of horizontal luminance lines (HLL's), each HLL having N number of luminance pixels. Thereafter, a luminance signal flare correction circuit 400 performs a luminance signal flare correction on HLL's of the Y on a HLL-by-HLL basis in accordance with the predetermined flare correction method to thereby supply a flare corrected luminance signal. Therefore, the flare correction apparatus of the present invention can perform flare correction on a digital image signal with less memory capacity and improve the flare correction accuracy over the prior art since the flare correction thereon is performed on a HL-by-HL basis.

FIG. 3

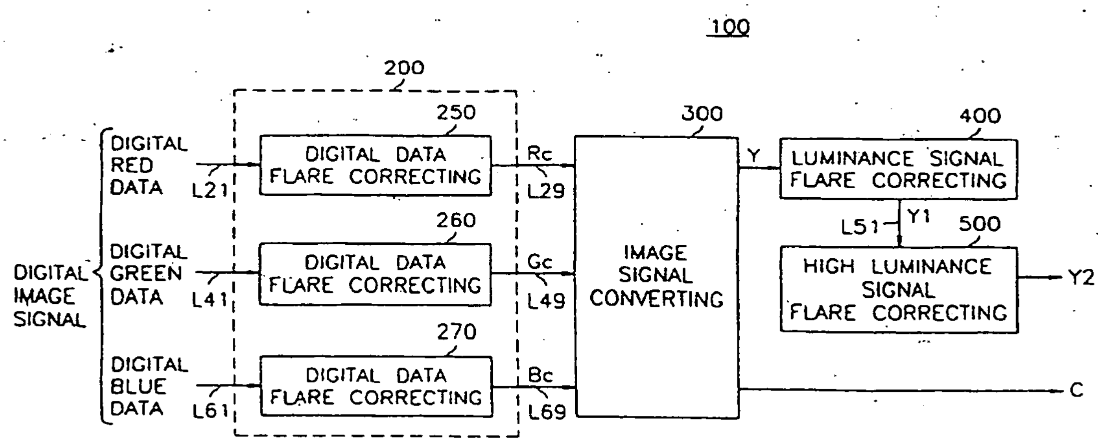

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FIG. 1
(PRIOR ART)

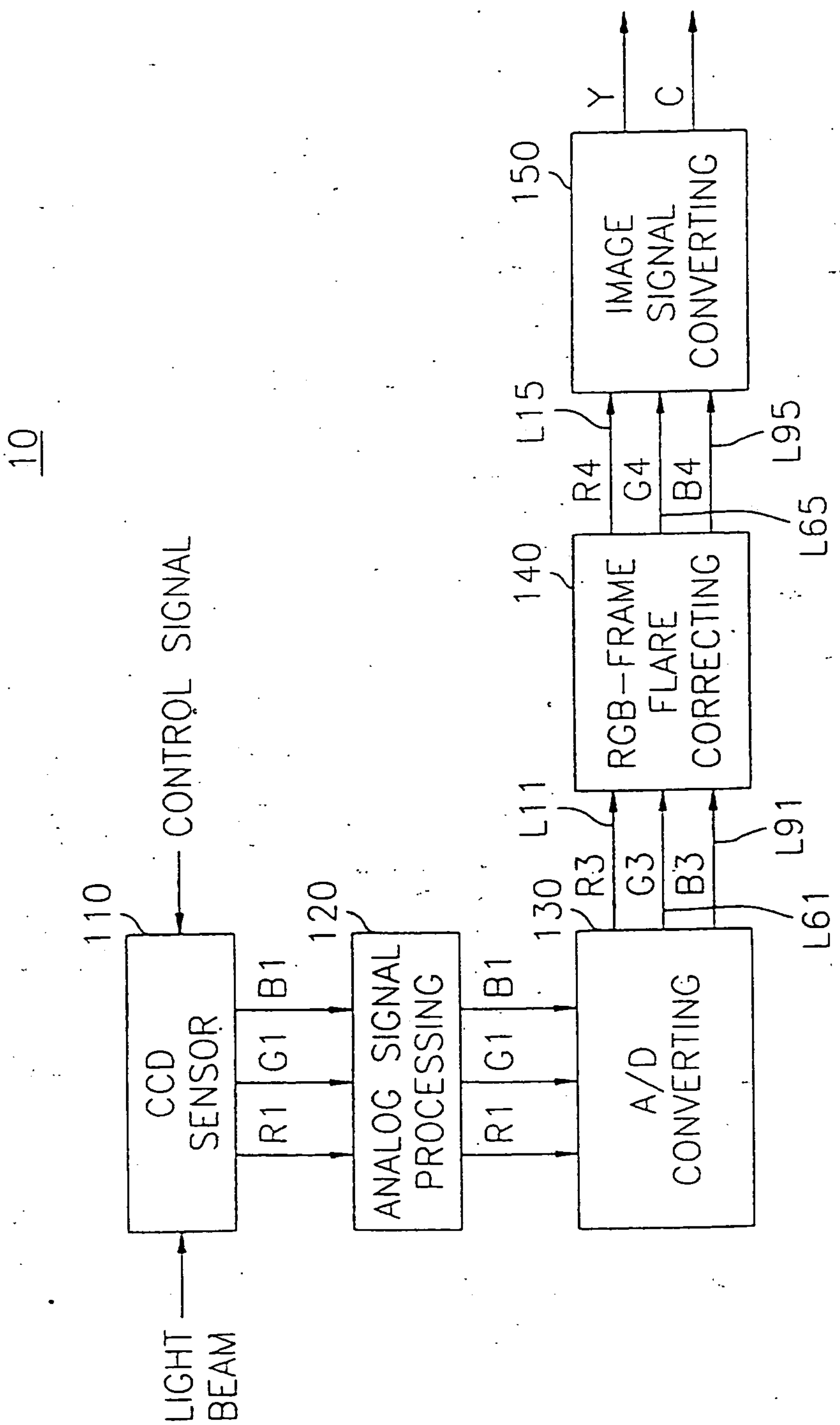


FIG. 2
(PRIOR ART)

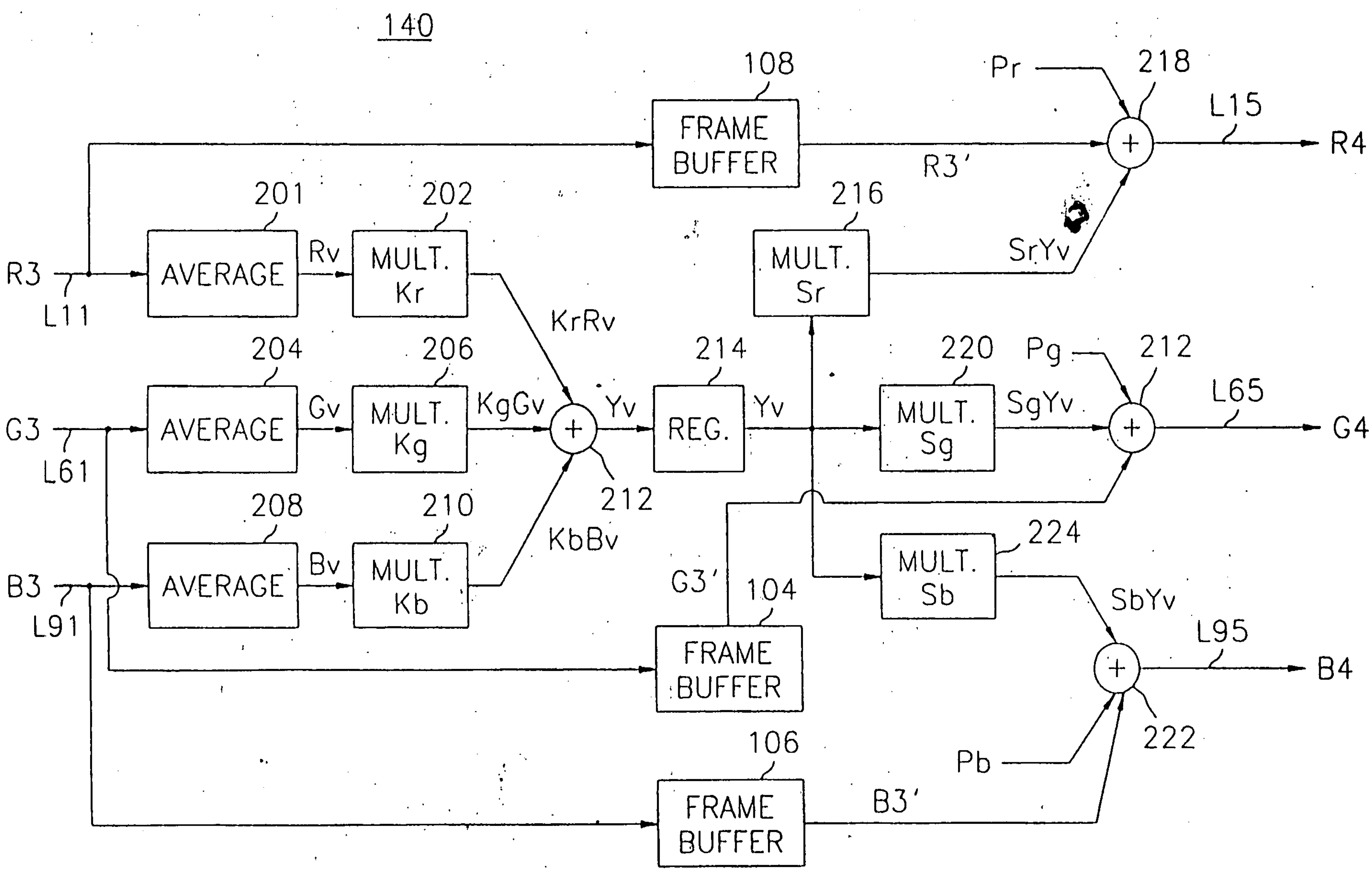


FIG.3

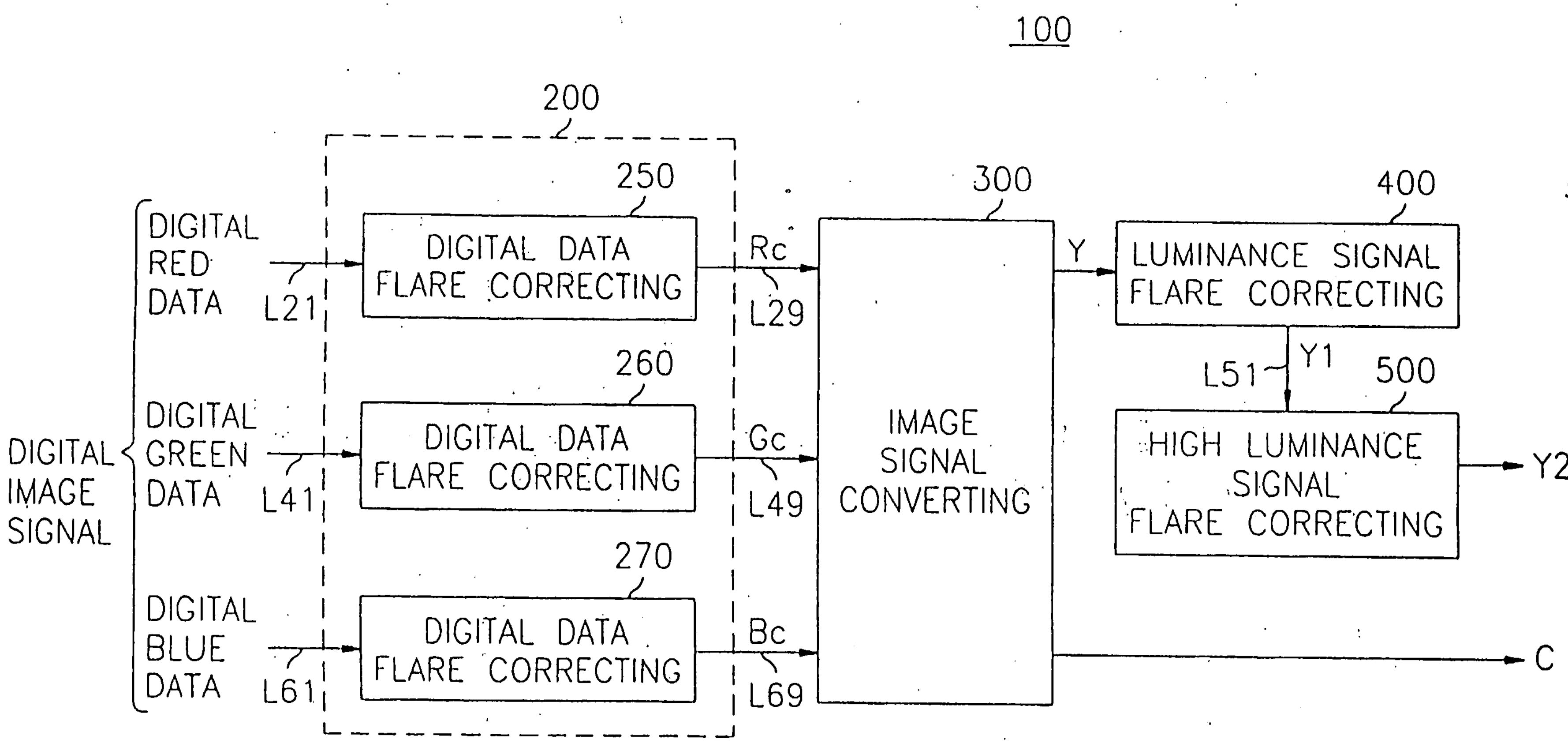

100
200
250
260
270
300
400
500
DIGITAL IMAGE SIGNAL
DIGITAL RED DATA
DIGITAL GREEN DATA
DIGITAL BLUE DATA
L21
L41
L61
DIGITAL DATA FLARE CORRECTING
DIGITAL DATA FLARE CORRECTING
DIGITAL DATA FLARE CORRECTING
Rc
L29
Gc
L49
Bc
L69
IMAGE SIGNAL CONVERTING
Y
LUMINANCE SIGNAL FLARE CORRECTING
Y1
L51
HIGH LUMINANCE SIGNAL FLARE CORRECTING
Y2
C

FIG. 4

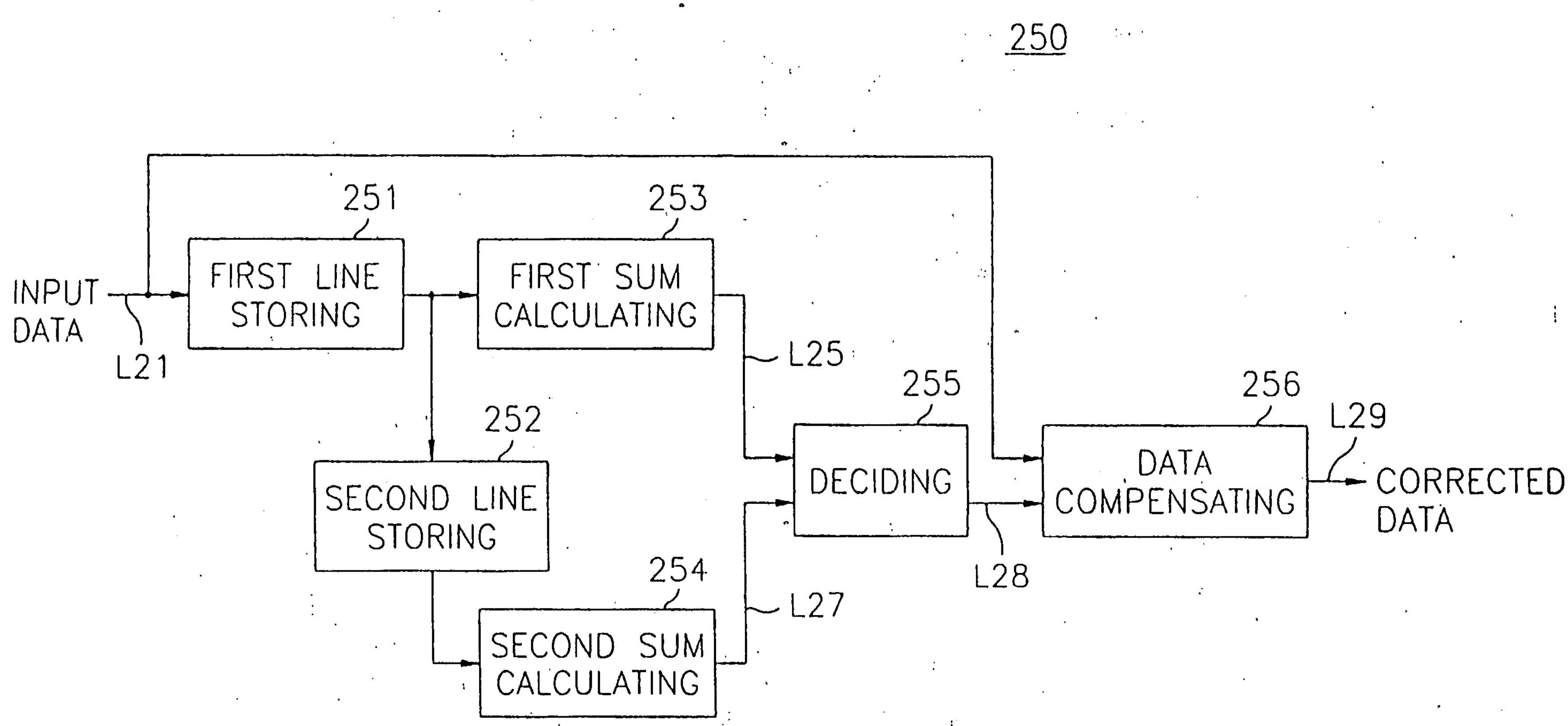

250
251
FIRST LINE STORING
252
SECOND LINE STORING
253
FIRST SUM CALCULATING
254
SECOND SUM CALCULATING
255
DECIDING
256
DATA COMPENSATING
INPUT DATA
L21
L25
L27
L28
L29
CORRECTED DATA

FIG.5

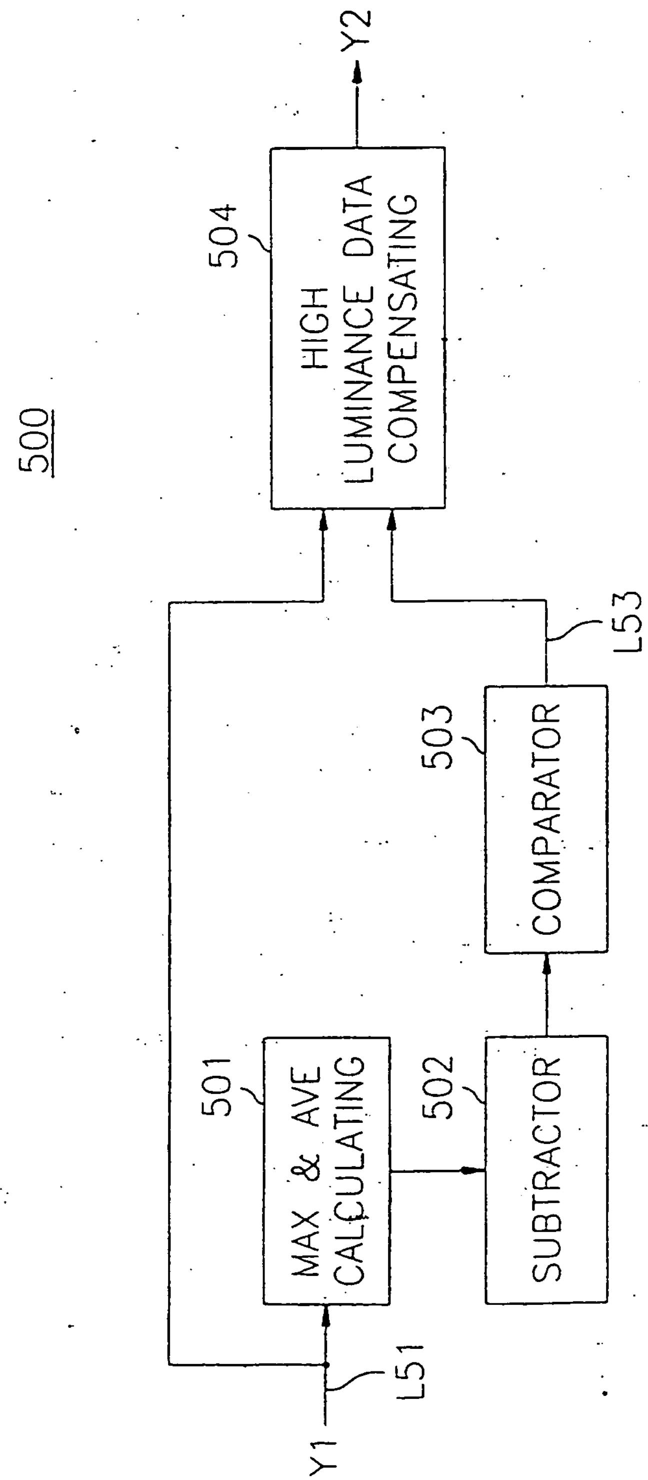

500
Y1
L51
501
MAX & AVE CALCULATING
502
SUBTRACTOR
503
COMPARATOR
L53
504
HIGH LUMINANCE DATA COMPENSATING
Y2

FIG. 6

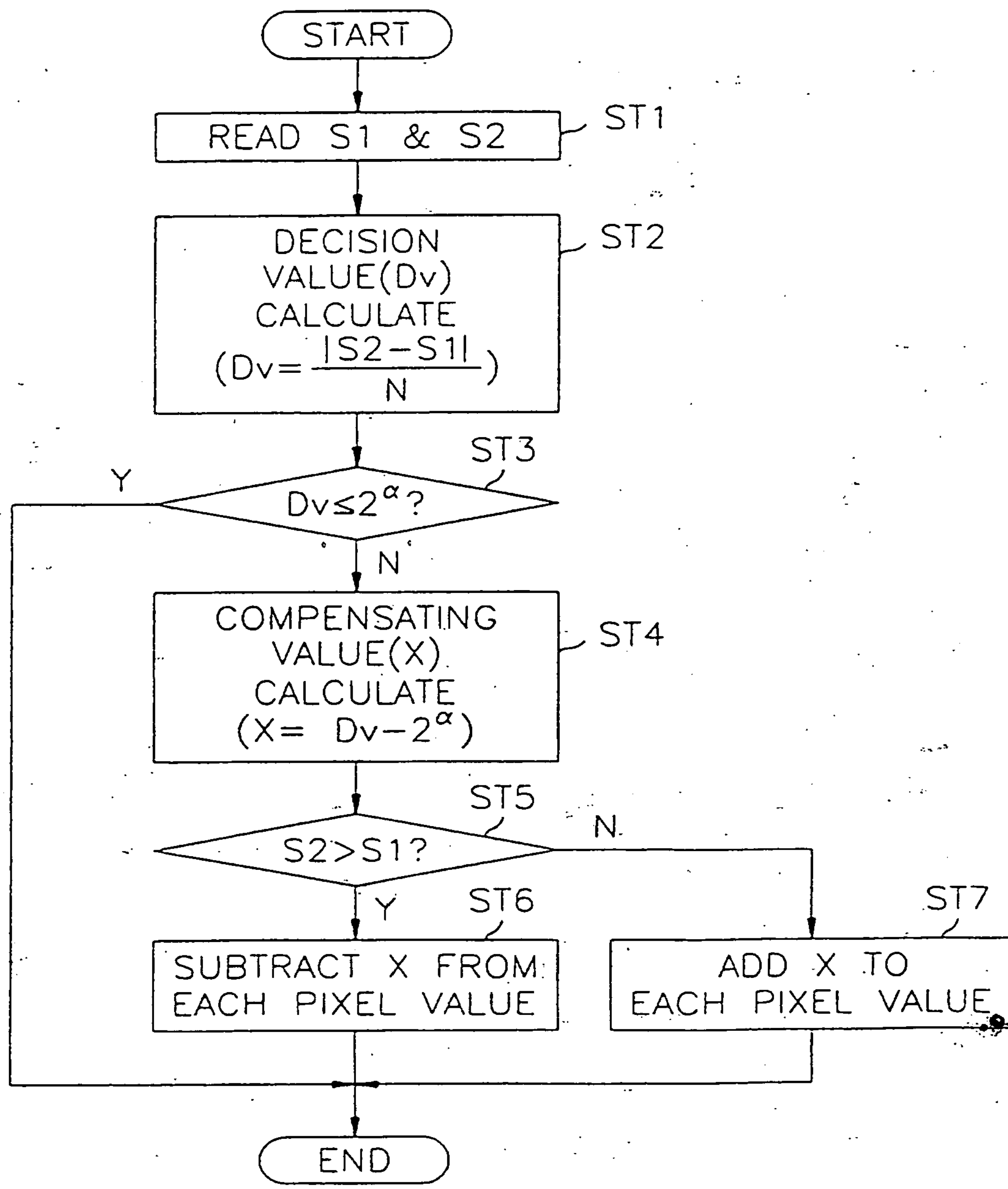
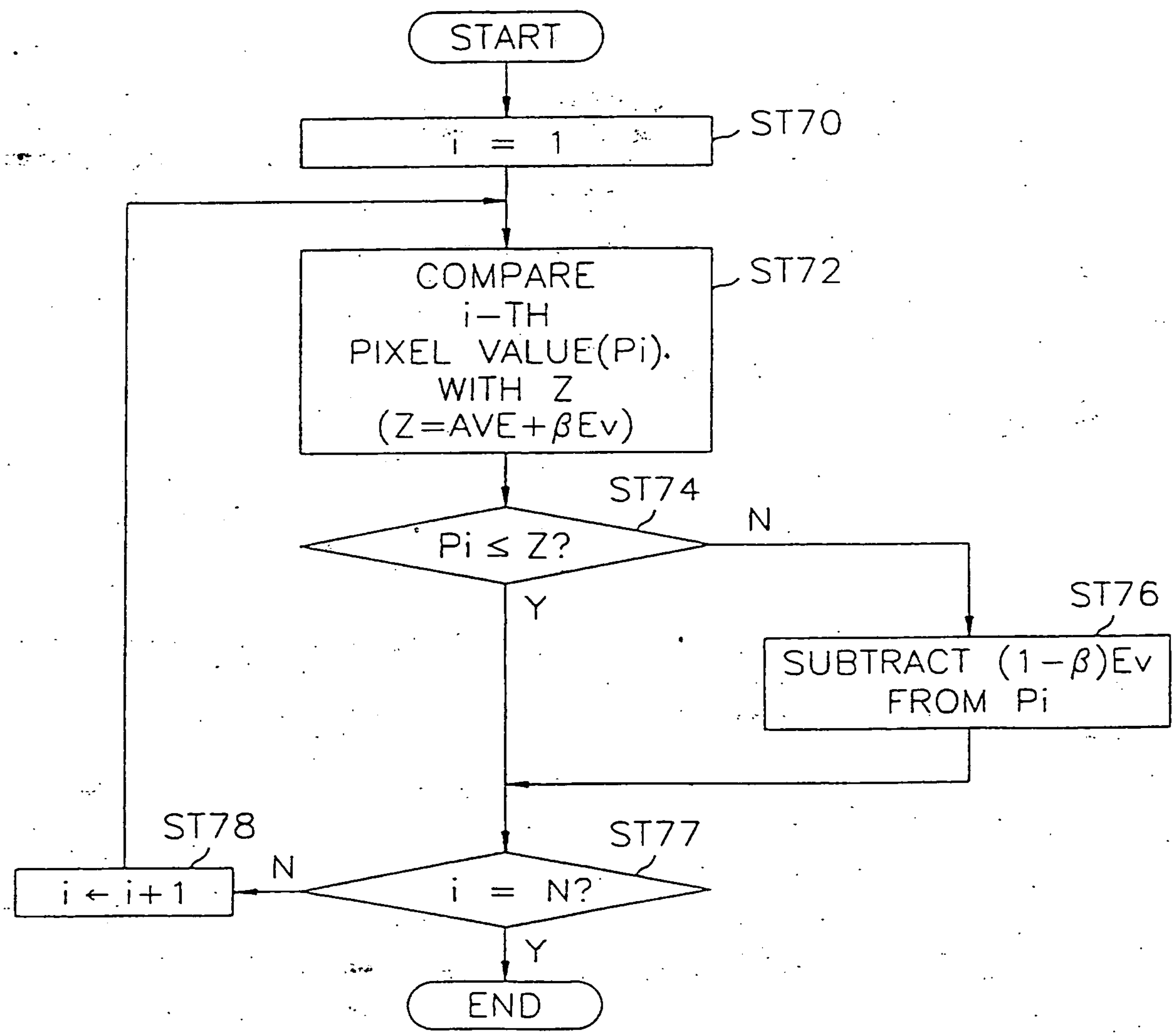

START
READ S1 & S2
ST1
DECISION VALUE(Dv) CALCULATE
(Dv= |S2−S1| / N)
ST2
ST3
Dv≤2^α?
Y
N
COMPENSATING VALUE(X) CALCULATE
(X= Dv−2^α)
ST4
ST5
S2>S1?
N
Y
ST6
SUBTRACT X FROM EACH PIXEL VALUE
ST7
ADD X TO EACH PIXEL VALUE
END

FIG.7


START
i = 1
ST70
COMPARE
i-TH
PIXEL VALUE(Pi)
WITH Z
(Z=AVE+βEv)
ST72
ST74
Pi ≤ Z?
N
Y
ST76
SUBTRACT (1-β)Ev
FROM Pi
ST78
ST77
i ← i+1
N
i = N?
Y
END

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FLARE CORRECTION METHOD AND APPARATUS FOR USE IN A CAMCORDER

The present invention relates to a flare correction method and apparatus; and, more particularly, to a flare correction method and apparatus for use in a camcorder to correct flare of a digital image signal.

As is well known in the art, in photographing a subject with a camcorder having both video camera and video cassette recorder functions, there may occur a phenomenon termed "flare". This flare is a phenomenon that an incident light beam from a subject being photographed is partially reflected and/or scattered with diffusion inside a camcorder to consequently cause a whitish fog within the reproduced image signal for the subject to thereby deteriorate the quality thereof. Increase of high luminance portions in the subject renders the flare of the reproduced image signal for the subject more conspicuous.

For the purpose of preventing such an undesired flare phenomenon, a camcorder is generally equipped with a flare correcting circuit so as to correct any flare of an input image signal. Fig. 1 shows a block diagram of a conventional camcorder 10 comprising a flare correcting circuit. The camcorder 10 comprises a charge coupled device (CCD) sensor

110, an analog signal processing circuit 120, an analog to digital (A/D) converting circuit 130, a RGB-frame flare correcting circuit 140 and an image signal converting circuit 150.

The CCD sensor 110 performs a photo-electric conversion of an incident light beam from a subject (not shown) into a corresponding photo-electric current in response to a control signal inputted thereto from a micro processor (not shown) in the camcorder 10 to thereby provide red data (R1), green data (G1) and blue data (B1) to the analog signal processing circuit 120. It should be noted here that each of the R1, G1 and B1 includes a stream of pixel values, wherein the pixel values collectively constitutes each of lines and lines collectively constitutes a frame.

The analog signal processing circuit 120 amplifies the R1, G1 and B1 and then removes or reduces noises included in the respective amplified R1, G1 and B1 to thereby provide the respective modified red data (R2), green data (G2) and blue data (B2) to the A/D converting circuit 130. The A/D converting circuit 130 performs A/D converting on the R2, G2 and B2 to thereby supply the respective digital red frame (R3), green frame (G3) and blue frame (B3) to the RGB-frame flare correcting circuit 140 via lines L11, L61 and L91, respectively.

The structure and functions of a conventional RGB-flare correcting circuit is illustrated in Fig. 2, which shows a

block diagram of the same RGB-frame flare correcting circuit 140 as that described in the U.S. Patent. No 5,155,586 issued to Yoram et al. This patent discloses a method and apparatus for flare correction to compensate an undesired luminance variation between frames (see, Fig. 4; and column 5, line 44 to column 6, line 36 of U.S. Patent No. 5,155,586).

In the RGB-frame flare correcting circuit 140, the R3, the G3 and the B3 are inputted to averaging circuits 201, 204 and 208 through the lines L11, L61 and L91, respectively; and at the same time, the R3, G3 and B3 are inputted to the frame buffers 108, 104 and 106 through the lines L11, L61 and L91, respectively.

The frame buffers 108, 104 and 106 store and delay the R3, G3 and B3 by one frame to thereby provide the respective one-frame delayed red frame (R3'), green frame (G3') and blue frame (B3') to adders 218, 212 and 222, respectively. It should be understood that the R3', G3' and B3' may be the respective previous digital red frame, green frame and blue frame.

The averaging circuits 201, 204 and 208 calculate average values (Rv), (Gv) and (Bv) for pixel values within the R3, G3 and B3 to thereby supply the Rv, the Gv and the Bv to the multiplication circuits 202, 206 and 210, respectively.

The multiplication circuits 202, 206 and 210 multiply the Rv, Gv and Bv by normalizing signals Kr, Kg and Kb to thereby provide KrRv, KgGv and KbBv to an adder 212, respectively,

wherein the normalizing signals Kr, Kg and Kb are predetermined values satisfying the relationship of: Kr+Kg+Kb=1. The adder 212 sums up the KrRv, KgGv and KbBv to thereby generate Yv=KrRv+KgGv+KbBv. The Yv is fed to multiplication circuits 216, 220 and 224 through a register 214.

The Yv is multiplied by a red flare correction factor (Sr) in multiplication circuit 216, by a green flare correction factor (Sg) in a multiplication circuit 220 and by a blue flare correction factor (Sb) in a multiplication circuit 224 to thereby generate SrYv, SgYv and SbYv, respectively, wherein the Sr, Sg and Sb are pre-selected constants. Typically, the magnitude of each of the Sr, Sg and Sb is fractional. The SrYv, SgYv and SbYv generated by the multiplication circuits 216, 220 and 224 are supplied to the adders 218, 212 and 222, respectively.

The adder 218 sums up the R3', the SrYv and a predetermined red lift correction signal (Pr) to thereby generate flare corrected red frame data (R4) on the line L15. The adder 212 sums up the G3', the SgYv and a predetermined green lift correction signal (Pg) to thereby generate flare corrected green frame data (G4) on the line L65. And the adder 222 sums up the B3', the SbYv and a predetermined blue lift correction signal (Pb) to thereby generate flare corrected blue frame data (B4) on the line L95. In the above, the Pr, Pg and Pb are preselected constants supplied from a

micro processor (not shown).

An image signal converting circuit 150 performs image signal converting on the R4, G4 and B4 by using a known image signal converting method to thereby generate a luminance signal and a chrominance signal.

The conventional flare correction apparatus and method such as described above, however, needs a large memory capacity and has a poor flare correction accuracy since flare correction on an input digital image signal is performed on a frame-by-frame basis. Therefore, the conventional flare correction apparatus and method has limitations in enhancing the flare correction accuracy and efficiency thereof.

It is, therefore, a primary object of the present invention to provide a flare correction method and apparatus to smooth undesired luminance variation between consecutive horizontal lines (HL's) of a digital image signal by performing flare correction thereon on a HL-by-HL basis.

In accordance with the present invention, there is provided a flare correction apparatus to correct flare of a digital image signal including digital red data (R), digital green data (G) and digital blue data (B), each of the R, G and B containing a plurality of HL's, each HL having N number of pixels with N being a predetermined positive integer, wherein said each of the R, G and B is obtained by amplifying and

digitizing a corresponding photo-electric current made by performing a photo-electric conversion on a light beam from a subject, the apparatus comprising: a RGB-data flare correction circuit for performing a flare correction on the R,G and B on a HL-by-HL basis in accordance with a first predetermined flare correction method to thereby provide flare corrected red data (Rc), flare corrected green data (Gc) and flare corrected blue data (Bc), respectively; an image signal converting circuit for performing an image signal conversion on the Rc, the Gc and the Bc to thereby generate a luminance signal (Y) and a chrominance signal, wherein said Y includes a plurality of horizontal luminance lines (HLL's), each HLL having N number of luminance pixels; and a luminance signal flare correction circuit performing a luminance signal flare correction on the Y on a HLL-by-HLL basis in accordance with the first predetermined flare correction method to thereby supply a first flare corrected luminance signal (Y1).

The above and other objects and features of the present invention will become apparent from the following description of preferred embodiments given in conjunction with the accompanying drawings, in which:

Fig. 1 shows a block diagram of a conventional camcorder comprising a flare correcting circuit;

Fig. 2 illustrates a detailed block diagram of a

the flare correcting circuit shown in Fig. 1;

Fig. 3 depicts a block diagram of a flare correction apparatus in accordance with a preferred embodiment of the present invention;

Fig. 4 represents a detailed block diagram of a digital data flare correcting circuit depicted in Fig. 3;

Fig. 5 presents a detailed block diagram of a high-luminance signal flare correcting circuit shown in Fig. 3;

Fig. 6 reveals a flow chart used to describe a flare correction method in accordance with the preferred embodiment of the present invention; and

Fig. 7 offers a flow chart used to describe a high luminance signal flare correction method in accordance with the preferred embodiment of the present invention.

In accordance with the present invention, there is provided a flare correction method and apparatus to correct flare of a digital image signal.

Referring to Fig. 3, there is depicted a block diagram of a flare correction apparatus 100 in accordance with a preferred embodiment of the present invention. The flare correction apparatus 100 comprises a RGB-data flare correcting channel 200, an image signal converting circuit 300, a luminance signal flare correcting circuit 400 and a high luminance signal flare correcting circuit 500. The RGB-data

flare correcting channel 200 includes three digital data flare correcting circuits 250, 260 and 270. It should be noticed here that in accordance with another embodiment of the present invention, the flare correction apparatus 100 does not include high luminance signal flare correction circuit 500.

First, a digital image signal including digital red data (R), digital green data (G) and digital blue data (B) is fed to the RGB-data flare correcting channel 200. Each of the R, G and B contains a plurality of horizontal lines (HL's), each HL having N number of pixels with N being a predetermined positive integer. And each of the R, G and B is obtained by amplifying and digitizing a corresponding photo-electric current made by performing a photo-electric conversion on a light beam from a subject (not shown).

The RGB-data flare correcting channel 200 performs a flare correction on the R, G and B on a HL-by-HL basis in accordance with a first predetermined flare correction method to thereby provide flare corrected red data (Rc), flare corrected green data (Gc) and flare corrected blue data (Bc) to the image signal converting circuit 300.

In detail, the R, G and B are fed to the digital data flare correcting circuits 250, 260 and 270 in the RGB-data flare correcting channel 200 via lines L21, L41 and L61, respectively. And then, the digital data flare correcting circuits 250, 260 and 270 perform a flare correction on the R, G and B on a HL-by-HL basis in accordance with the first

predetermined flare correction method to thereby provide the Rc, Gc and Bc to the image signal converting circuit 300 via lines L29, L49 and L69, respectively.

Referring to Fig. 4, there is represented a detailed block diagram of the digital data flare correcting circuit 250 depicted in Fig. 3. The data flare correcting circuit 250 includes a first line storing circuit 251, a second line storing circuit 251, a first sum calculating circuit 253, a second sum calculating circuit 254, a deciding circuit 255 and a data compensating circuit 256.

It should be noted here that the digital data flare correcting circuit 250, the digital data flare correcting circuit 260 and the digital data flare correcting circuit 270 have the same structure and functions. Therefore, for simplicity, only the structure and function of the digital data flare correcting circuit 250 will be described hereinafter. And it should be also noted here that the first predetermined flare correction method is the method or the rule used in the flare correction performed by the digital data flare correcting circuit 250. Hence, the first predetermined flare correction method should be fully understood by referring the description for the structure and function of the digital data flare correcting circuit 250.

In the digital data flare correcting circuit 250, first, input data is fed to the first line storing circuit 251 and the data compensating circuit 256 through a line L21. The

first line storing circuit 251, e.g., as a buffer, stores the input data on a HL-by-HL basis and then provides a current HL of the input data to the first sum calculating circuit 253 and the second line storing circuit 252.

The second line storing circuit 252 first retrieves a previous HL of the input-data previously stored therein as a reference HL and then supplies the reference HL to the second sum calculating circuit 254. And then the second line storing circuit 252 stores the current HL as a previous HL to the subsequent HL of the input data. It should be noted that if the current HL is the topmost HL in a corresponding frame, the current HL is set as the reference HL thereof.

The first sum calculating circuit 253 calculates a first sum (S1) by summing up all of the pixel values of the current HL and then provides the S1 to the deciding circuit 255 via a line L25. The second sum calculating circuit 254 calculates a second sum (S2) by summing up all of the pixel values of the reference HL and then provides the S2 to the deciding circuit 255 via a line L27. It should be noted that the S1 and the S2 are sums of pixel values within the consecutive HL's of the input data.

The deciding circuit 255 decides flare correction mode for the current HL to provide a flare correction mode signal based on the comparison result after calculating a decision value (Dv) and comparing the Dv with a first predetermined threshold (TH1) to the data compensating circuit 256 via a

line L28, wherein the Dv is calculated by using the first sum and the second sum.

In accordance with a preferred embodiment of the present invention, the Dv by using Eq. 1 represented as:

$$Dv=\frac{|S2-S1|}{N} \quad (Eq.\ 1).$$

And the TH1 is 2^{α}, α being a predetermined integer ranging from 0 to 5.

The data compensating circuit 256, in response to the flare correction mode signal, performs data compensation on pixel values of the current HL of the input data inputted thereto via the line L21 based on the Dv to thereby generate a corresponding HL of flare corrected data (Fc) on a line L29. It should be noted that in the digital data compensating circuit 250, the Fc is the Rc since the input data inputted thereto is R. And in the digital data compensating circuit 260 and 270, the Fc's are the Gc and Bc since the input data inputted thereto are G and B, respectively.

In detail, the deciding circuit 255 generates a first flare correction mode signal (FC1) on the line L28 if the Dv is not greater than the TH1, a second flare correction mode signal (FC2) on the line L28 if the S2 is greater than the S1 under the condition that the Dv is greater than the TH1 and a third flare correction mode signal (FC3) on the line L29 if the S2 is equal to or less than the S1 under the condition that the Dv is greater than the TH1.

The data compensating circuit 256 generates the current HL of the input data as a corresponding HL of a Fc in response to the FC1; subtracts a compensation value (X) from each of the pixels of the current HL in response to the FC2 to thereby generate a corresponding HL of the Fc; and adds the X to each of the pixels of the current HL in response to the FC3 to thereby generate a corresponding HL of the Fc on the line L29; wherein the X is obtained by subtracting the TH1 from the Dv.

Fig. 6 reveals a flow chart used to describe a flare correction, especially a flare correction method or a flare correction rule used in flare correction process performed by deciding circuit 255 and the data compensating circuit 256 in accordance with the preferred embodiment of the present invention. From now on, referring to Fig. 6, a flare correction process in accordance with the preferred embodiment of the present invention.

In the flare correction process, first the S1 and the S2 are read at step ST1. And then at step ST2, the Dv is calculated. Thereafter, the Dv is compared with the TH1 at step ST3. At step ST3, if the Dv is equal to or less than the TH1, e.g., 2^{α}, the process is ended and if the Dv is greater than the TH1 the process flows to step ST4.

At step ST4, the X is calculated by subtracting the TH1 from the Dv. And then, at step ST5, if the S2 is greater than the S1 the process goes to step ST6 and if the S2 is less than the S1 the process proceeds to step ST7.

At step ST6, the X is subtracted from each pixel value of the current HL of the input data and then the process is ended. And at step ST7, the X is added to each pixel value of the current HL and then the process is ended.

The image signal converting circuit 300 performs an image signal conversion on the Rc, Gc and Bc by using a conventional image signal conversion method to thereby generate a luminance signal (Y) and a chrominance signal, wherein the Y includes a plurality of horizontal luminance lines (HLL's), each HLL having N number of luminance pixels.

The luminance signal flare correcting circuit 400 performs a flare correction on the Y inputted thereto from the image signal converting circuit 300 on a HLL-by-HLL basis in accordance with the first predetermined flare correction method to thereby supply a first flare corrected luminance signal (Y1) to the high luminance signal flare correcting circuit 500 via a line L71. The description for the flare correction process performed by the luminance signal flare correcting circuit 400 is omitted since the structure and function thereof is the same as that of the digital data flare correcting circuit 250.

The high luminance signal flare correcting circuit 500 performs a high luminance signal flare correction on high luminance pixels within each of the HLL's of the Y1 to thereby produce a second flare corrected luminance signal (Y2), wherein each of the high luminance pixels is defined and then

flare corrected in accordance with a second predetermined flare correction method.

Fig. 5 presents a detailed block diagram of the high-luminance signal flare correcting circuit 500 shown in Fig. 3. The high-luminance signal flare correcting circuit 500 includes a maximum value (MAX) and an average value (AVE) calculating circuit 501, a subtractor 502, a comparator 503 and a high luminance data compensating circuit 504. In the high-luminance signal flare correcting circuit 500, first the Y1 is inputted to the MAX & AVE calculating circuit 501 and the high luminance data compensating circuit 504 via the line L71.

The MAX & AVE calculating circuit 501 detects a maximum value (MAX) among all luminance pixel values within a HLL of the Y1 and then calculates an average value (AVE) for all pixel values within the HLL of the Y1 to thereby provide the MAX and the AVE to the subtractor 502.

The subtractor 502 subtracts the AVE from the MAX to thereby supply a evaluation value (Ev) to the comparator 503. The comparator 503 compares the Ev with a second predetermined positive threshold (TH2) to thereby provide a first compensation signal if the Ev is equal to or less than the TH2 and a second compensation signal if the Ev is greater than the TH2 to the high luminance data compensating circuit 504 via a line L73. The high luminance data compensating circuit 504 produces the HLL of the Y1 as a corresponding HLL of a Y2 in

response to the first compensation signal and performs high luminance data compensation on the high luminance pixels of the horizontal of the Y1 in response to the second compensation signal to thereby produce a corresponding HLL of a Y2.

In accordance with a preferred embodiment of the present invention, a high luminance signal flare correction process or method described hereinafter is selected as the second predetermined flare correction method. Fig. 7 offers a flow chart used to describe a high luminance signal flare correction method in accordance with the preferred embodiment of the present invention.

First at step ST70, i is set as 1. And then, at step ST72, an ith luminance pixel value (Pi) within the HLL of the Y1 is compared with a third predetermined threshold (TH3), wherein the TH3 is Z=AVE+ßEv, ß being a predetermined value typically ranging from 0.7 to 0.9 and i is an integer ranging from 1 to N.

Thereafter, at step ST74, the Pi is compared with the TH3, i.e., Z, and then the process goes to step ST76 if the Pi is greater than the TH3 and the process flows to step ST77 if the Pi equal to or less than the TH3.

At step ST76, the Pi is defined as a high luminance pixel value and then (1-ß)Ev is subtracted from the Pi and in turn the process proceeds to step ST77. At step ST77, the process proceeds to step ST78 if i is equal to N and the process is

ended if i is not equal to N. At step ST78, i is increased by 1 and then the process returns to step ST72.

In brief, in the high luminance data compensating circuit 504, in response to the second compensation signal, a Pi within the horizontal luminance line of the Y1 is compared with Z and then the Pi is defined as a high luminance pixel value and then the (1-ß)Ev is subtracted from the Pi if the Pi is greater than Z. In this way, the high luminance data compensating circuit 504 performs high luminance data compensation on all of the luminance pixel values within all HLL's of the Y1 to thereby produce the Y2.

As described above, in accordance with a flare correction method and apparatus of the present invention, flare correction on a digital image signal can be performed with less memory capacity and advanced flare correction accuracy than the prior art since the flare correction on the digital image signal is performed on a HL-by-HL basis. Therefore, the flare correction method and apparatus of the present invention can enhance the flare correction accuracy and efficiency thereof.

While the present invention has been described with respect to the particular embodiments, it will be apparent to those skilled in the art that various modifications and changes may be made without departing from the scope of the invention as defined in the following claims.

Claims

1. A flare correction apparatus to correct flare of a digital image signal including digital red data (R), digital green data (G) and digital blue data (B), each of the R, G and B containing a plurality of horizontal lines (HL's), each HL having N number of pixels with N being a predetermined positive integer, wherein said each of the R, G and B is obtained by amplifying and digitizing a corresponding photo-electric current made by performing a photo-electric conversion on a light beam from a subject, the apparatus comprising:

means for performing a RGB-data flare correction on the R, G and B on a HL-by-HL basis in accordance with a first predetermined flare correction method to thereby provide flare corrected red data (Rc), flare corrected green data (Gc) and flare corrected blue data (Bc), respectively;

means for performing an image signal conversion on the Rc, the Gc and the Bc to thereby generate a luminance signal (Y) and a chrominance signal, wherein said Y includes a plurality of horizontal luminance lines (HLL's), each HLL having N number of luminance pixels; and

means for performing a luminance signal flare correction on the Y on a HLL-by-HLL basis in accordance with the first predetermined flare correction method to thereby supply a first flare corrected luminance signal (Y1).

2. The apparatus according to claim 1, wherein the RGB-data flare correction means includes three digital data flare correcting circuits having the same structure and functions, each of the digital data flare correcting circuits containing:

means for first line storing to store input data on a HL-by-HL basis and then provide a current HL of the input data, wherein the input data is one of the R, G and B;

means for second line storing to retrieve a previous HL of the input data previously stored therein and then supply the previous HL as a reference HL and then store the current HL as a previous HL to the subsequent HL of the input data, wherein if the current HL of the input data is the topmost HL in a corresponding frame, the current HL is supplied as the reference HL thereof;

first means for calculating a first sum (S1) by summing up all of the pixel values of the current HL;

second means for calculating a second sum (S2) by summing up all of the pixel values of the reference HL;

means for deciding a flare correction mode for the current HL based on the comparison result obtained by calculating a decision value (Dv) and then comparing the Dv with a first predetermined threshold (TH1) to thereby provide a flare correction mode signal, wherein the Dv is calculated by using the first sum and the second sum; and

means, in response to the flare correction mode signal, for performing a data compensation on all pixel values within

the current HL of the input data based on the Dv to thereby generate a corresponding HL of flare corrected data (Fc), wherein the Fc is the Rc if the input data is the R, the Gc if the input data is the G, and Bc if the input data is the B.

3. The apparatus according to claim 2, wherein the first predetermined flare correction method is the method used in the flare correction performed by each of the digital data flare correcting circuits.

4. The apparatus according to claim 3, wherein the flare correction mode deciding means calculates the Dv by using Eq. 1 represented as:

$$Dv=\frac{|S2-S1|}{N} \qquad (Eq.\ 1).$$

5. The apparatus according to claim 4, wherein the flare correction mode deciding means generates a first flare correction mode signal (FC1) if the Dv is equal to or less than the TH1, a second flare correction mode signal (FC2) if the S2 is greater than the S1 under the condition that the Dv is greater than the TH1, and a third flare correction mode signal (FC3) if the S2 is less than the S1 under the condition that the Dv is greater than the TH1.

6. The apparatus according to claim 5, wherein the data compensation means generates the current HL of the input data as the corresponding HL of the Fc in response to the FC1; subtracts a compensation value (X) from each of the pixel values of the current HL in response to the FC2 to thereby generate the corresponding HL of the Fc; and adds the X to each of the pixel values of the current HL in response to the FC3 to thereby generate the corresponding HL of the Fc, wherein the X is obtained by subtracting the TH1 from the Dv.

7. The apparatus according to claim 6, wherein the TH1 is 2^{α}, α being a predetermined integer ranging from 0 to 5.

8. The apparatus according to claim 1, further comprising:

means for performing a high luminance signal flare correction on high luminance pixels within each of the HLL's of the Y1 on a HLL-by-HLL basis to thereby produce a second flare corrected luminance signal (Y2), wherein each of the high luminance pixels is defined and then flare corrected in accordance with a second predetermined flare correction method.

9. The apparatus according to claim 8, wherein the high luminance signal flare correction means includes:

means for detecting a maximum value (MAX) among all pixel values within a HLL of the Y1 and then calculating an average

value (AVE) for all pixel values within the HLL thereof to thereby provide the MAX and the AVE;

means for subtracting the AVE from the MAX to thereby supply an evaluation value (Ev);

means for comparing the Ev with a second predetermined positive threshold (TH2) to thereby provide a first compensation signal if the Ev is equal to or less than the TH2 and a second compensation signal if the Ev is greater than the TH2; and

means for producing the HLL of the Y1 as a corresponding HLL of the Y2 in response to the first compensation signal and performing a high luminance data compensation on the high luminance pixels of the HLL of the Y1 in response to the second compensation signal to thereby produce a corresponding HLL of the Y2.

10. The apparatus according to claim 9, wherein, in accordance with the second predetermined flare correction method, in response to the second compensation signal, an ith luminance pixel value (Pi) within the HLL of the Y1 is compared with a third predetermined threshold (TH3), wherein the TH3 is Z=AVE+ßEv, ß being a predetermined value ranging from 0.7 to 0.9; and then if the Pi is greater than the TH3, the Pi is defined as a high luminance pixel value and then the (1-ß)Ev is subtracted from the Pi to thereby produce the corresponding HLL of the Y2, wherein i ranges from 1 to N.

11. A flare correction method for use in an apparatus to correct flare of a digital image signal including digital red data (R), digital green data (G) and digital blue data (B), each of the R, G and B containing a plurality of horizontal lines (HL's), each HL having N number of pixels with N being a predetermined positive integer, wherein said each of the R, G and B is obtained by amplifying and digitizing a corresponding photo-electric current made by performing a photo-electric conversion on a light beam from a subject, the method comprising the steps of:

(a) performing a RGB-data flare correction on the R, G and B on a HL-by-HL basis in accordance with a first predetermined flare correction rule to thereby provide flare corrected red data (Rc), flare corrected green data (Gc) and flare corrected blue data (Bc), respectively;

(b) carrying out an image signal conversion on the Rc, the Gc and the Bc to thereby generate a luminance signal (Y) and a chrominance signal, wherein said Y includes a plurality of horizontal luminance lines (HLL's), each HLL having N number of luminance pixels; and

(c) executing a luminance signal flare correction on the Y on a HLL-by-HLL basis in accordance with the first predetermined flare correction rule to thereby supply a first flare corrected luminance signal (Y1).

12. The method according to claim 11, wherein the step (a) includes the steps of:

(a1) first line storing to store input data on a HL-by-HL basis and then provide a current HL of the input data, wherein the input data is one of the R, G and B;

(a2) second line storing to retrieve a previous HL of the input data previously stored therein and then supply the previous HL as a reference HL and then store the current HL as a previous HL to the subsequent HL of the input data, wherein if the current HL of the input data is the topmost HL in a corresponding frame, the current HL is supplied as the reference HL thereof;

(a3) calculating a first sum (S1) by summing up all of the pixel values of the current HL;

(a4) calculating a second sum (S2) by summing up all of the pixel values of the reference HL;

(a5) deciding a flare correction mode for the current HL based on the comparison result obtained by calculating a decision value (Dv) and then comparing the Dv with a first predetermined threshold (TH1) to thereby generate a flare correction mode signal, wherein the Dv is calculated by using the first sum and the second sum; and

(a6) performing a data compensation on all pixel values within the current HL of the input data based on the Dv if the flare correction mode signal is generated at the step (a5) to thereby generate a corresponding HL of flare corrected data

(Fc), wherein the Fc is the Rc if the input data is the R, the Gc if the input data is the G, and Bc if the input data is the B.

13. The method according to claim 12, wherein the first predetermined flare correction rule is the rule for use in the flare correction performed by said steps (a1) to (a6).

14. The method according to claim 13, wherein the Dv is calculated by using Eq. 1 represented as:

$$Dv=\frac{|S2-S1|}{N} \quad (Eq.\ 1).$$

15. The method according to claim 14, wherein in the step (a5), a first flare correction mode signal (FC1) is generated if the Dv is equal to or less than the TH1; a second flare correction mode signal (FC2) is generated if the S2 is greater than the S1 under the condition that the Dv is greater than the TH1; and a third flare correction mode signal (FC3) is generated if the S2 is less than the S1 under the condition that the Dv is greater than the TH1.

16. The method according to claim 15, wherein in the step (a6), the current HL of the input data is produced as the corresponding HL of the Fc if the FC1 is generated at said step (a5); a compensation value (X) is subtracted from each

of the pixel values of the current HL if the FC2 is generated at said step (a5) to thereby generate the corresponding HL of the Fc; and the X is added to each of the pixel values of the current HL if the FC3 is generated at said step (a5) to thereby generate the corresponding HL of the Fc, wherein the X is obtained by subtracting the TH1 from the Dv.

17. The apparatus according to claim 16, wherein the TH1 is 2^{α}, α being a predetermined integer ranging from 0 to 5.

18. The method according to claim 11, further comprising the step of:

(d) performing a high luminance signal flare correction on high luminance pixels within each of the HLL's of the Y1 on a HLL-by-HLL basis to thereby produce a second flare corrected luminance signal (Y2), wherein each of the high luminance pixels is defined and then flare corrected in accordance with a second predetermined flare correction rule.

19. The method according to claim 18, wherein the step (d) includes the steps of:

(d1) detecting a maximum value (MAX) among all pixel values within a HLL of the Y1 and then calculating an average value (AVE) for all pixel values within the HLL thereof to thereby provide the MAX and the AVE;

(d2) subtracting the AVE from the MAX to thereby supply

an evaluation value (Ev);

(d3) comparing the Ev with a second predetermined positive threshold (TH2) to thereby generate a first compensation signal if the Ev is equal to or less than the TH2 and a second compensation signal if the Ev is greater than the TH2; and

(d4) producing the HLL of the Y1 as a corresponding HLL of the Y2 if the first compensation signal is generated at said step (d3) and performing a high luminance data compensation on the high luminance pixels of the HLL of the Y1 if the second compensation signal is generated at said step (d3) to thereby produce a corresponding HLL of the Y2.

20. The method according to claim 19, wherein, in accordance with the second predetermined flare correction rule, if the second compensation signal is generated at said step (d3), an ith luminance pixel value (Pi) within the HLL of the Y1 is compared with a third predetermined threshold (TH3), wherein the TH3 is Z=AVE+ßEv, ß being a predetermined value ranging from 0.7 to 0.9; and then if the Pi is greater than the TH3, the Pi is defined as a high luminance pixel value and then the (1-ß)Ev is subtracted from the Pi to thereby produce the corresponding HLL of the Y2, wherein i ranges from 1 to N.

21. A flare correction apparatus to correct flare of a digital image signal constructed and arranged substantially

as herein described with reference to or as shown in Figures 3 to 5 of the accompanying drawings.

22. A flare correction method

substantially as herein described with reference to or as shown in Figures 3 to 7 of the accompanying drawings.

CHARTER MARK

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Claims searched: 1-22

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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): H4F FHHX,FHHB,FHHD

Int Cl (Ed.6): H04N 5/217,5/213,5/228

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB 2054318 A (Philips)	
A	EP 0507593 A2 (Sony)	
A	US 5155586 (Sony)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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